



STEM for Britain 2024
House of Commons
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"Net zero is the economic opportunity of the 21st century"

"We must act decisively to seize the opportunities in a global race"

Independent Review of Net Zero, 2023

What is the problem?

- Decarbonising aviation is a global challenge. The UK aerospace sector must act now to be a part of this radical change – this is essential to not only protect the environment, but also to protect the UK aerospace industry.

What are the solutions?

- Net zero concepts for civilian aircraft require more mass efficient structures.
- Composite materials can provide this, but to fully extract the mass saving benefit, we must develop solutions which make them more resistant to damage.

Profiling concept for leading edge protection

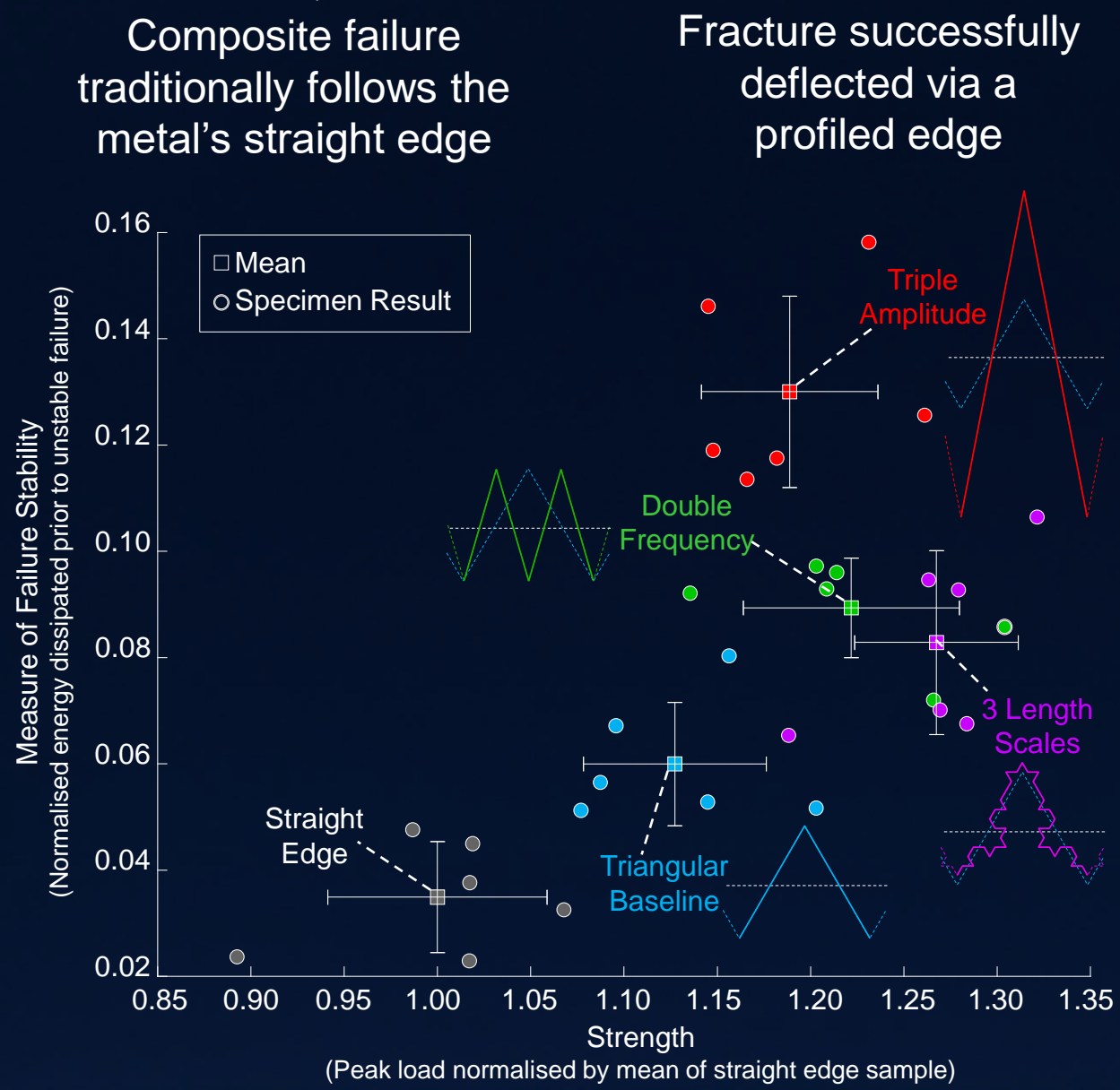
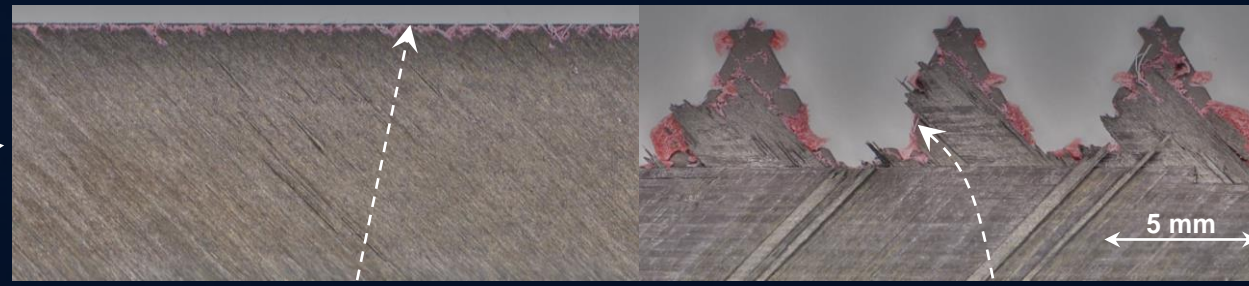
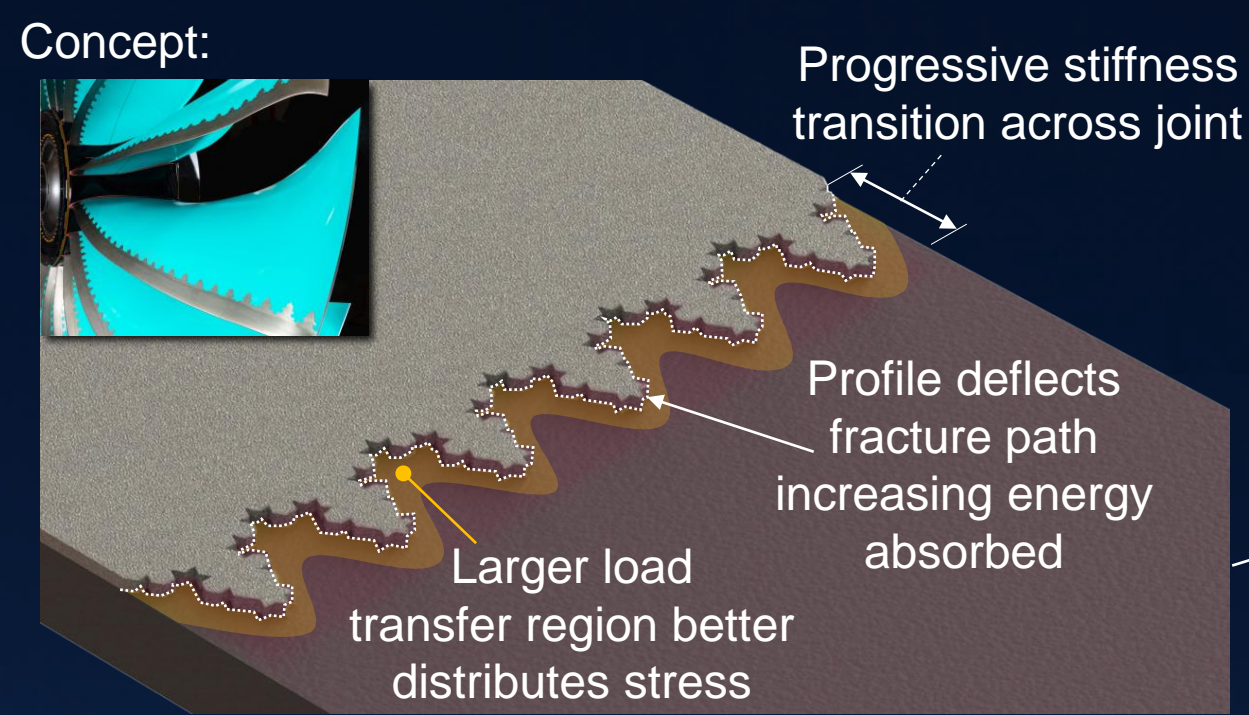


Feature:

- Metallic erosion shields are used to protect composite leading edges on blades and wings

Vulnerability:

- The step change in stiffness at the edge of the erosion shield can accelerate failure in the composite part



Profiled designs show increased strength and a more stable failure – results received recognition from SAMPE UK & Ireland

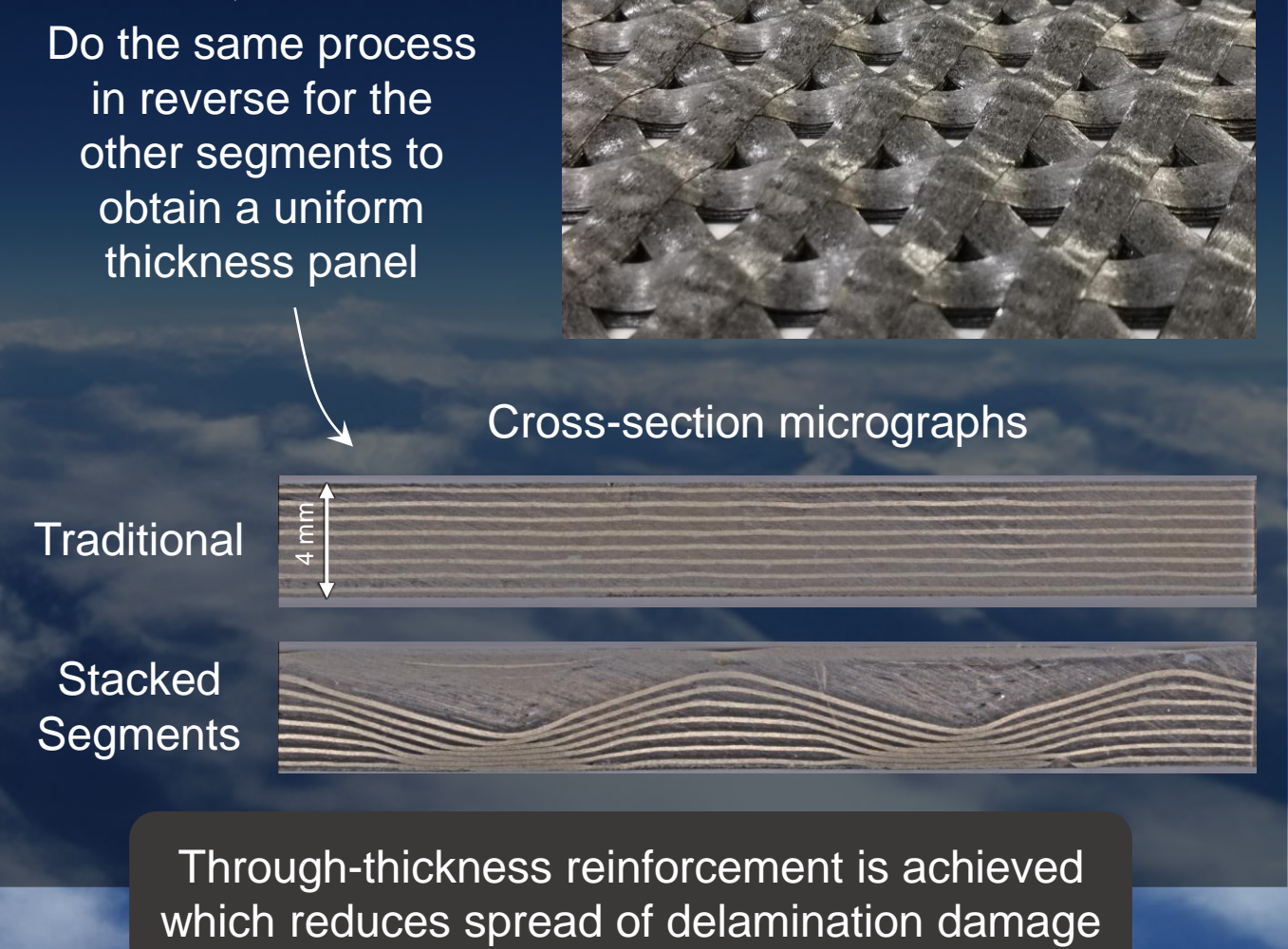
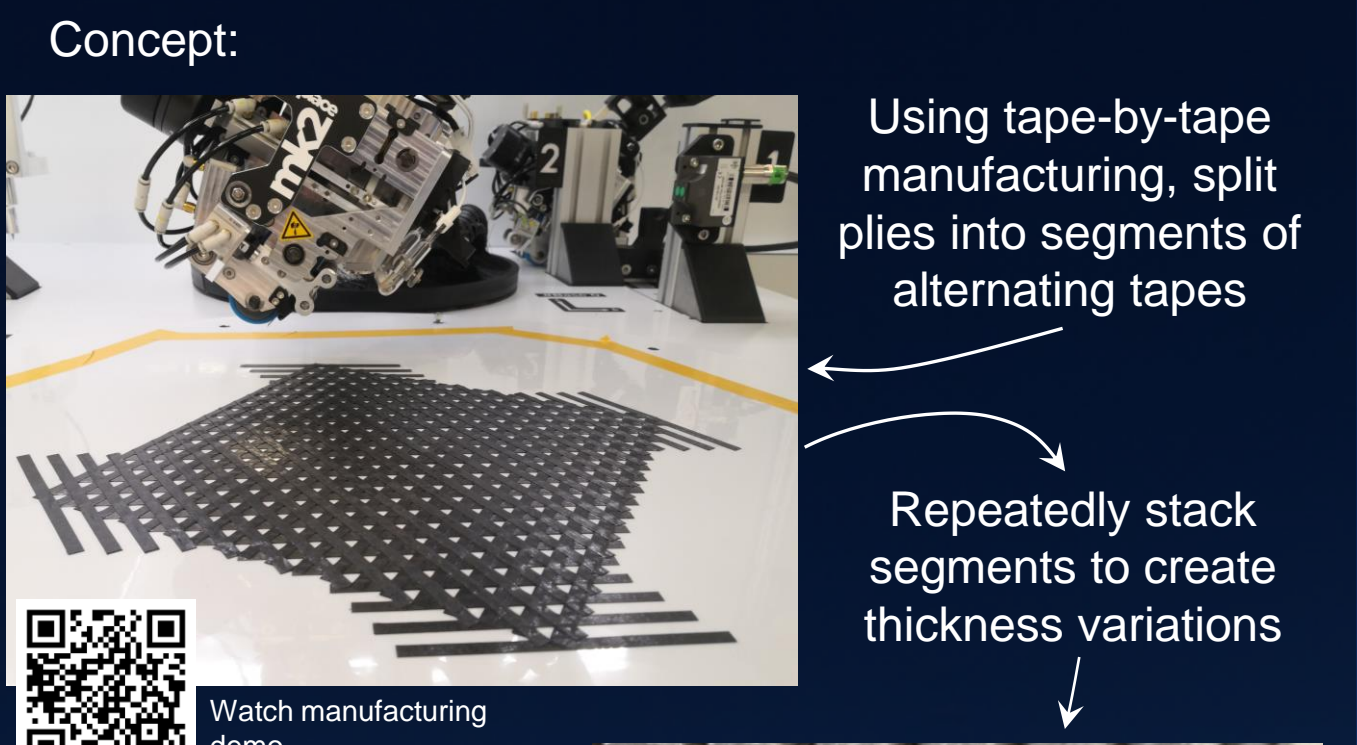
3D reinforcement for delamination resistance

Feature:

- Composites are usually manufactured as 'laminates' – many layers of fibres pressed together with each layer comprising fibres of a single orientation

Vulnerability:

- These layers can separate (delamination), resulting in a rapid loss of stiffness and structural integrity



Bio-inspired embedded stiffener for improved damage tolerance

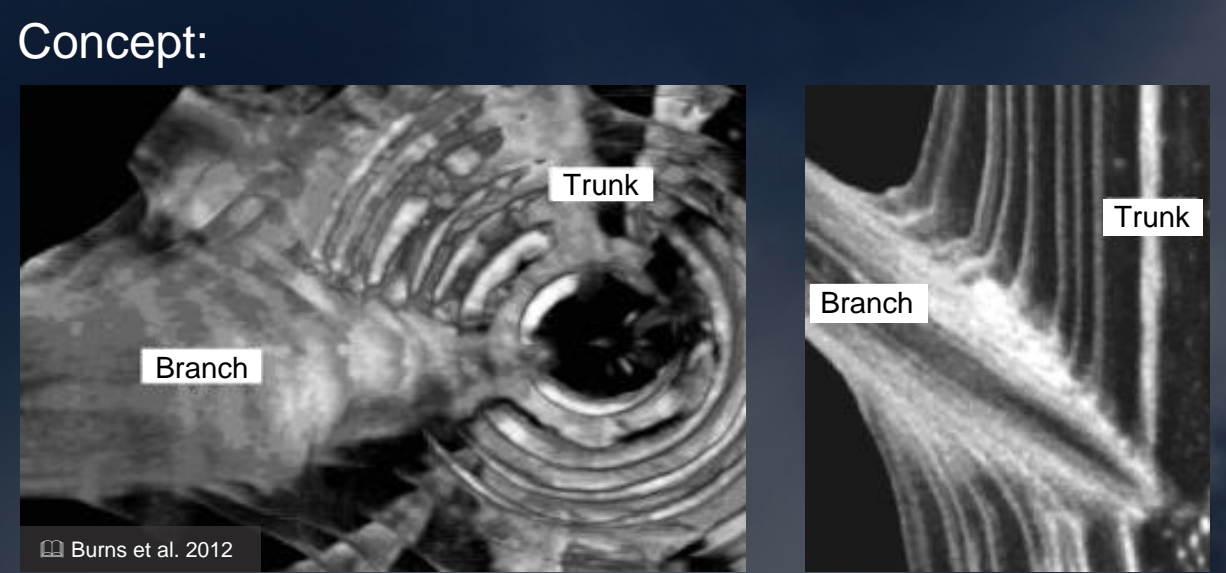
Feature:

- Composite stiffened panels are composed of 'skins' with 'stiffeners' bonded to the surface
- They are used to provide structural stiffness in a mass efficient manner

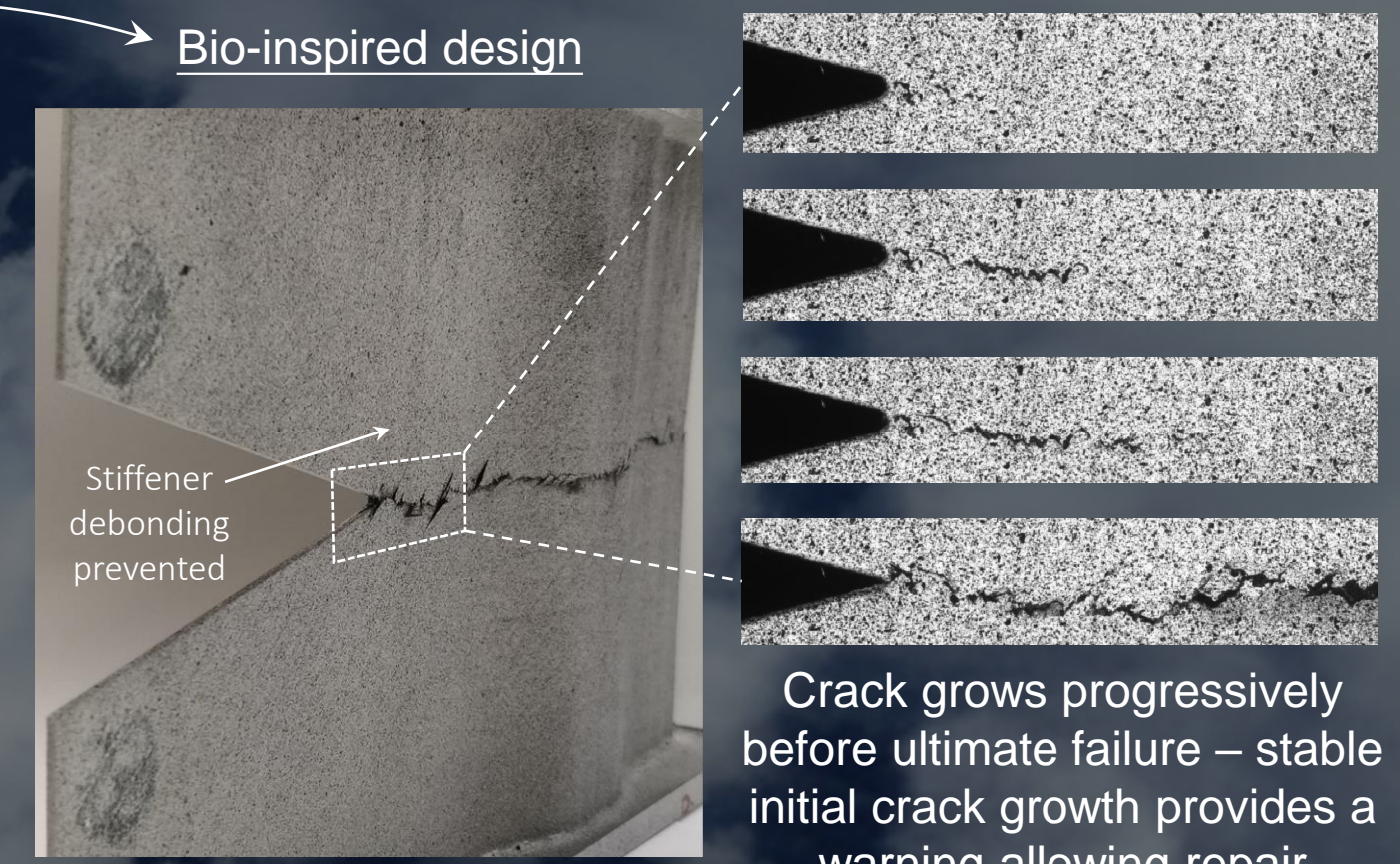
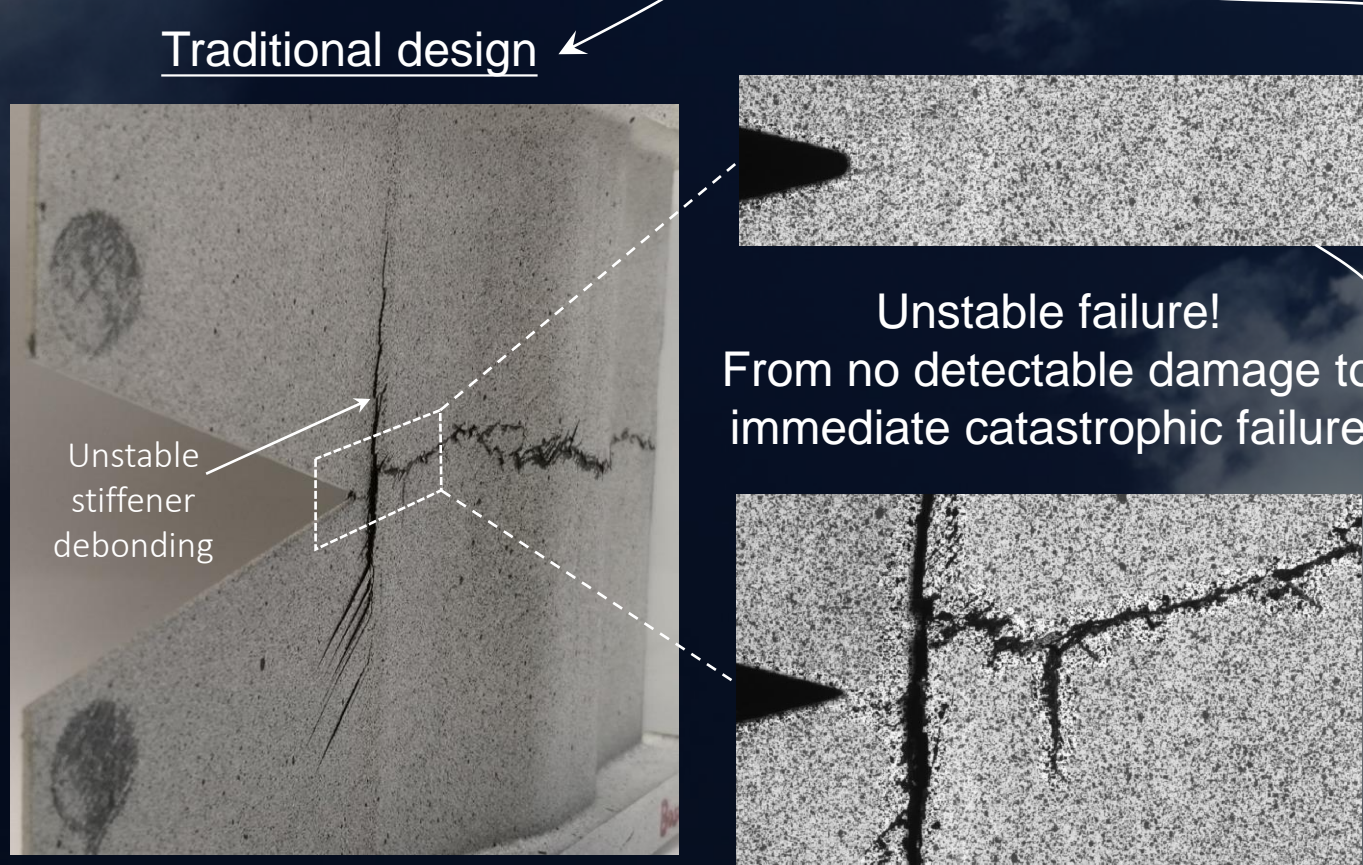
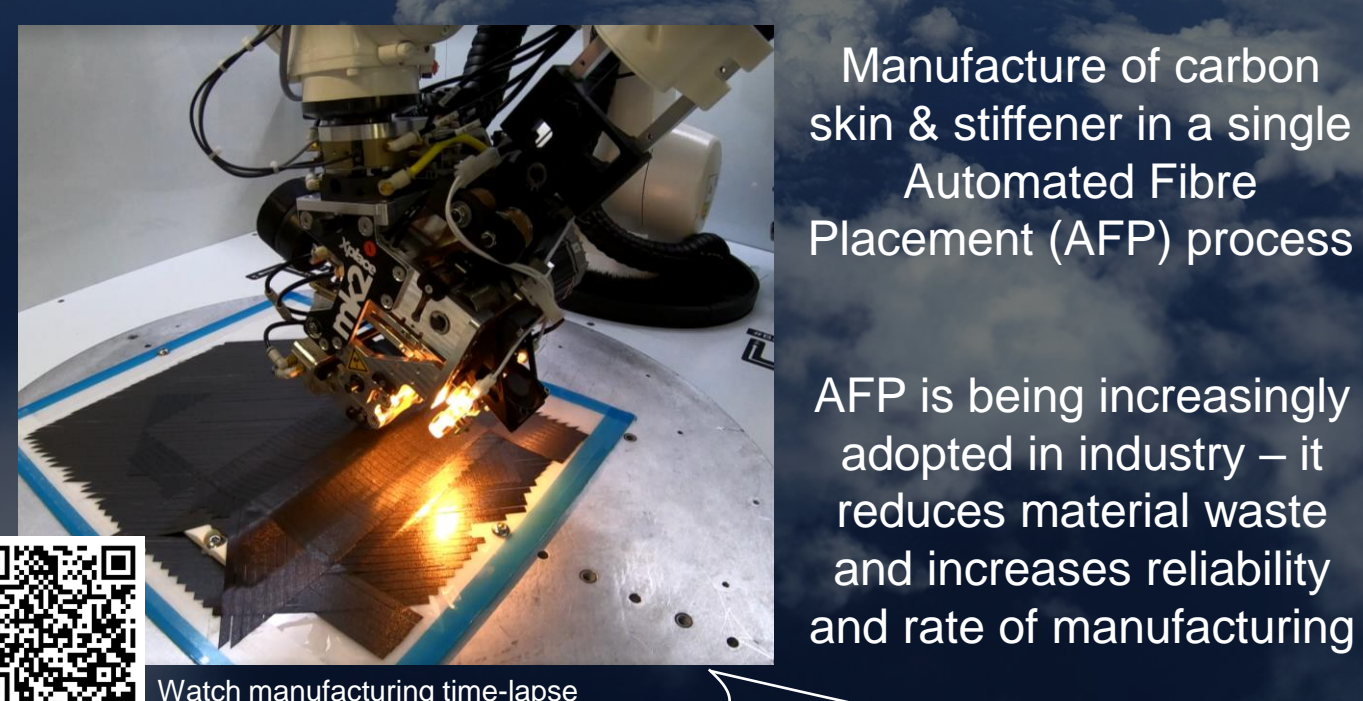
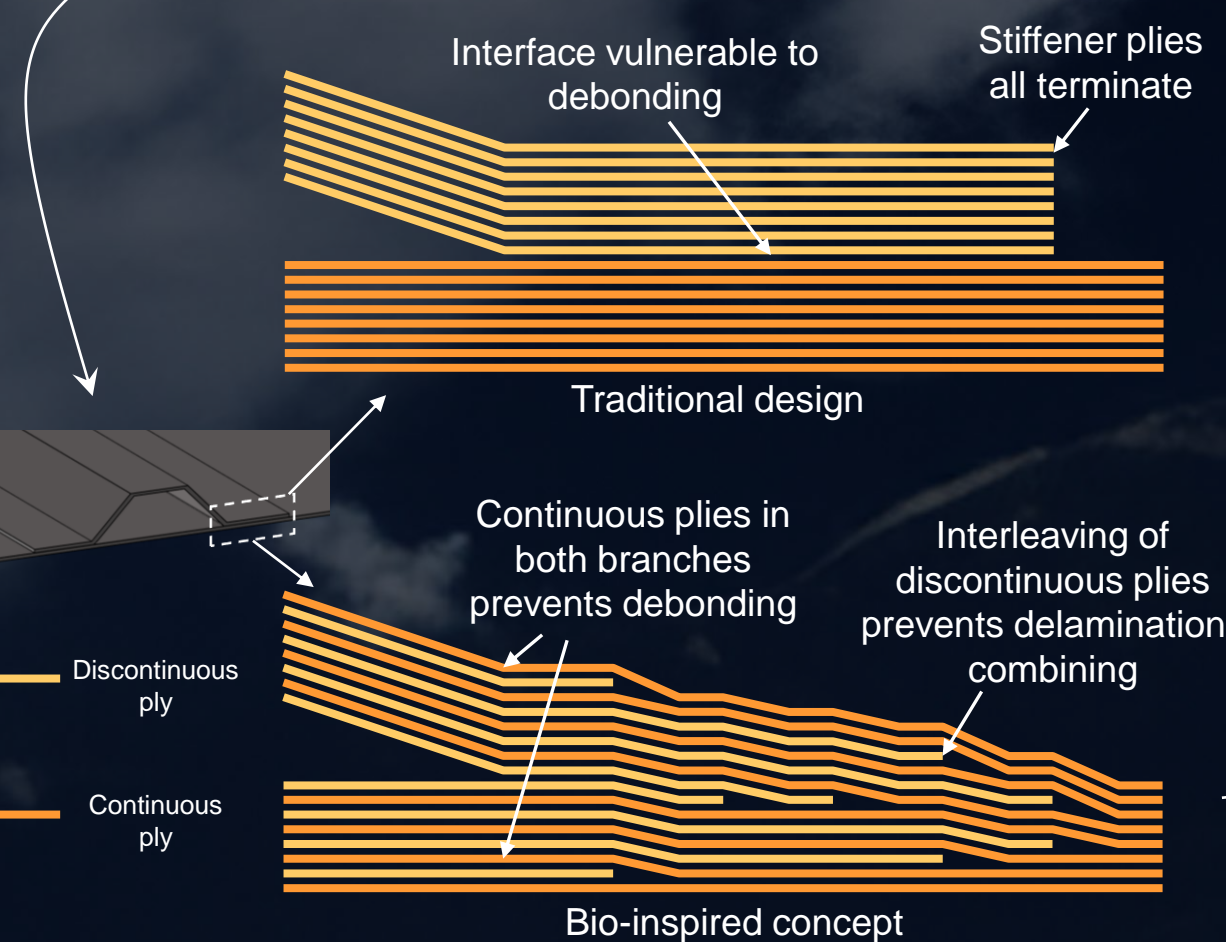
Vulnerability:

Stiffeners are vulnerable to separation failure!

This results in a sudden loss of structural integrity!



I designed a composite stiffened panel with the stiffener attachment embedded to the centre of the skin inspired by this biological structure



Bio-inspired design manufactured successfully via AFP and is seen to prevent separation failure

Conclusions & future direction

- We have developed innovative new concepts which demonstrate composite materials can be used to create damage resistant structures and by extension the aircraft of the future
- To capitalise on the net zero opportunity the demonstrated concepts must be applied at a higher TRL level with industry partners to realise our end goal of net zero aviation

